nature geoscience

SUPPLEMENTARY INFORMATION

DOI: 10.1038/NGEO2971

In the format provided by the authors and unedited.

The deep atmosphere of Venus and the possible role of density-driven separation of CO_2 and N_2

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T (K)	p (bars)	ρ_1 (kg/m^3)	ρ_2 (ideal) (kg/m^3)	$\delta(\rho)$ (%)	c_p CO_2 (J/kg/K)	c_p N_2 (J/kg/K)	c_{p1} (Venus) (J/kg/K)	c_{p2} (J/kg/K)	$\delta(c_p)$ (%)
500	10	10.664	10.584	-0.75	1027.3	1056.8	1028.3	1029.6	0.13
575	20	18.536	18.407	-0.70	1079.0	1069.3	1078.7	1081.2	0.23
650	50	40.921	40.707	-0.52	1133.8	1084.4	1132.1	1128.6	-0.31
700	70	52.922	52.920	0.00	1162.5	1095.7	1160.1	1158.3	-0.16
750	100	70.417	70.560	0.20	1191.1	1107.7	1188.2	1186.6	-0.13

Table S1. Densities and specific heat capacities in Venus's deep atmospheric conditions. Densities ρ_1 of pure CO_2 at several temperatures (T) and pressures (p) relevant for Venus's deep atmosphere based on a full equation of state[35] are compared to the ideal gas law ρ_2. The difference $\delta(\rho) = (\rho_2 - \rho_1)/\rho_1$ is expressed in percentage and remains below 0.8%. Specific heat capacities c_{p1} for the Venusian atmospheric composition (96.5% CO_2, 3.5% N_2) are computed from CO_2 (Ref. 35) and N_2 (Ref. 41) values, and compared to the values of $c_{p2} = c_{p0}(T/T_0)^\nu$ (Ref. 40). $\delta(c_p) = (c_{p2} - c_{p1})/c_{p1}$ is expressed in percentage and remains below 0.4%.

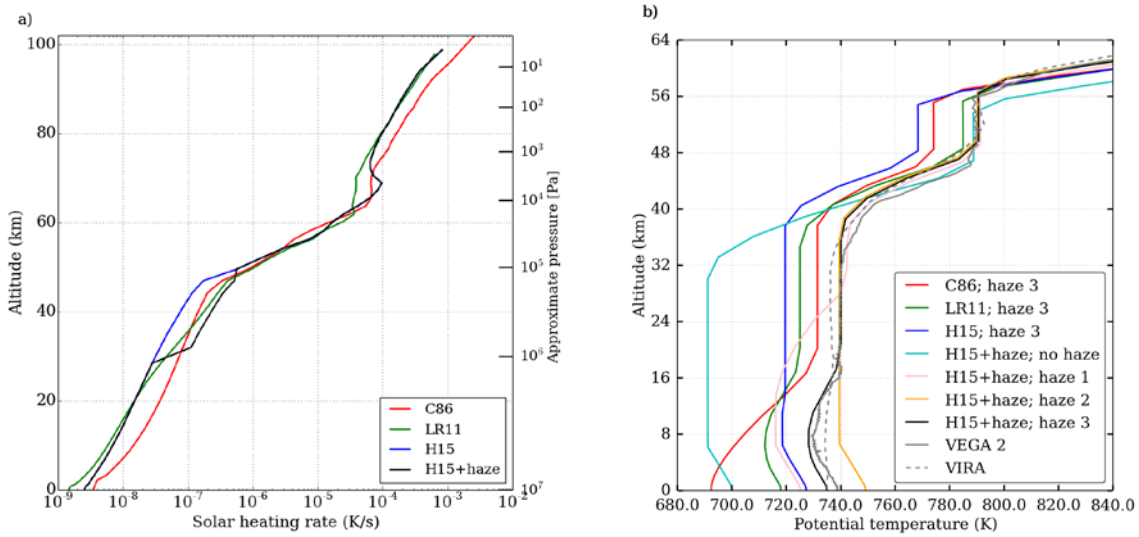

Figure S1 | Solar heating rates and potential temperature profiles in 1-dimensional radiative-convective simulations. (a) Solar heating rate models: C86 (red)[49], LR11 (green)[50], H15 (blue)[48]. The black model, nominal case, is H15 with an additional heating in the haze layer below the cloud base (30-48 km). (b) Vertical profiles of potential temperature θ for several simulations using a 1-dimensional globally averaged version of the LMD Venus GCM[38] Sensitivity to the solar model is plotted with the same colors as in (a). To study the sensitivity to additional continuum (in the range 3 to 7 microns) below the clouds, different haze models are used: no haze (cyan); a continuum of 1.3×10^{-6} cm^{-1} amagat^{-2} is added in the lower haze region (30-48 km, haze 1, pink) or everywhere below the clouds (0-48 km, haze 2, orange); the nominal case is similar to haze 1, but with an additional continuum of 4×10^{-7} cm^{-1} amagat^{-2} in the 16-30 km region (haze 3, black). The negative gradient of potential temperature with respect to height in the lowest 7 km does not imply convective instability, but is related to the assumption of a vertical gradient in mean molecular density (see text for details).